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PREVENTION OF ENCROACHMENT ON ARABLE LAND IN AFRICA

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I. INTRODUCTION

1. The problem of encroachment on arable lands in Africa has been under inter-agency consultations between FAO, UNEP, IFAD, the Organization of African Unity (OAU) and the Economic Commission for Africa (ECA) at two previous meetings which were held at ECA, Addis Ababa, in April 1982 and at FAO, Rome in September 1983 respectively. At that time when the severity of the African food situation was demanding programmes and plans of action such as the Lagos Plan of Action (1980) and the FAO African Food Plan (1980), the twin problems of post-harvest food losses and of arable land lost to urban development in Africa were considered for joint action. But since FAO has then launched many projects to counteract post-harvest food losses in almost all developing countries whilst the problem of encroachment on arable lands is still inadequately studied, it was decided at the second inter-agency consultations at FAO, Rome, to consider the problems separately, and that ECA should organize a consultative meeting of experts from African Governments, the United Nations system and others from outside Africa to discuss the problem.

2. An Expert Group Meeting on Encroachment on Arable Lands in Africa was then held at ECA, Addis Ababa, 16-20 September 1985. The meeting was organized by ECA in collaboration with UNEP, FAO and UNESCO experts from nine African countries were invited on a subregional basis as well as on the degree of soil degradation (slight* or severe+) as indicated below:

(a)	Northern Africa	Morocco* and Sudan+
(b)	Eastern Africa	Tanzania* and Ethiopia+
(c)	Southern Africa	Zimbabwe* and Mozambique+
(d)	Western and Central Africa	Nigeria*, Côte d'Ivoire* and Mali

The Chairman of the Expert Group Meeting was Nigeria and Cote d'Ivoire provide the rapporteur.

3. The opening statement presented by a representative of the Executive Secretary of ECA, spelt out the purpose of the Expert Group Meeting as well as what the experts were expected to achieve. The representative said that the present crisis in food production which has resulted in generalized food shortages and famine in the region, highlighted the importance that must be attached to issues dealing with the management of all arable lands in the region. He said that the loss of arable land due to human activity and poor development planning and land use management in all the sectors had become a serious problem in Africa. He emphasized that the problems of encroachment on arable lands fell squarely within the framework of land use degradation and management in town and country planning for settlement location, natural resources development and the location of industry, in relation to their impacts on the area of land under agricultural cultivation and animal husbandry.

4. The representative of the Executive Secretary continued by saying that land was a limited, virtually non-renewable resource and that the portion of it that was arable was even more limited. It would, therefore, be useful, he said, to consider seriously issues relating to (a) settlement schemes,

particularly resettlement schemes, taking into account their impact on the available agricultural land; (b) natural resources development which could also pose the serious problem of reducing the area of farmland, if rehabilitation measures are not undertaken; and (c) industrial location which could also be very problematic to agricultural land availability around towns. He reiterated that the experts were faced with complex problems, touching on all sectors of development, which needed very careful consideration if practical recommendations were to be made to member States, particularly those that were under serious pressure from the impact of drought and desertification. The experts, he said, were to review ongoing activities and identify gaps that still existed in the realization of those activities, and then make recommendations for integrated programmes on methods for filling the information gaps identified, for the development of criteria and methodologies for assessing and monitoring changes in land use patterns in developing countries, for the building of an inventory of supporting institutional infrastructure in African countries, for assessing and monitoring encroachment on arable land, and for evaluating their adequacy or otherwise for satisfactorily achieving the goals.

5. The main working document (E/ECA/ENV/24) presented by ECA at the Expert Group Meeting contained the following sections which have been improved upon in the light of the discussions at the meeting as document E/ECA/ENV/24/Rev.1 to focus squarely on the problem of encroachment on arable land and to make recommendations for action to solve the problem. The recommendations for action at the national, regional and international levels are found at the end of the paper.

II. LAND USE SITUATION IN AFRICA

6. The problem of encroachment on arable land in Africa hinges on the land use situation in Africa. It is noted from the FAO/UNESCO World Soil Map 1/ that the total potentially cultivable land in Africa is estimated at 789 million hectares in 1980, out of a total land area of 2,873 million hectares (excluding South Africa), which is only 27.4 per cent of the continent. Of this, 181 million hectares is now under cultivation in 1981, which is 23 per cent of the total potential reserve in Africa. FAO estimates this figure to rise to 226 million hectares by the year 2000, 2/ which will be 28.6 per cent of the total potentially cultivable land in Africa. If only about a quarter of the potential arable lands in Africa will be used by the turn of the century, which is only 6 to 8 per cent of the continental surface, why is there a problem of encroachment on arable lands?

1/ FAO/UNESCO World Soil Map.

2/ FAO: Agriculture towards the year 2000.

7. Although Africa seems to have an inexhaustible supply of arable land, current trends and reports from other regions in the world are indicating a serious loss of existing cultivated land due to soil degradation because of unsuitable agricultural management practices as well as loss of existing and potential prime agricultural land for non-agricultural purposes. Because of the uneven distribution of this ostensibly inexhaustible supply of arable land within Africa, small countries with high population density as well as those influenced by other limiting factors, are beginning to feel the pinch. In summary, the following factors are currently limiting the availability of arable land and its economic utilization for development in several African countries, namely:

(a) High population pressure on existing arable land especially in North and West Africa, leading to urban encroachment and unlimited growth of cities;

(b) Previous misuse of arable land and inaccessibily of virgin lands due to topography;

(c) Prolonged drought and water scarcity for irrigation, especially in the aridlands;

(d) Soil degradation and soil erosion in existing arable lands;

(e) Prevalence of debilitating water-borne diseases (such as river blindness and sleeping sickness) in river valleys and flood plains near large dams and tse-tse flies preventing cattle ranching in coastal areas;

(f) Natural calamities such as landslides, hurricane frequency, flooding;

(g) Desertification processes eating up human settlements in the aridlands;

(h) Deforestation and devegetation by removal of the protective soil cover in the humid zones; and

(i) Intensive shifting cultivation with inadequate fallow for the soil to recuperate leading to soil degradation.

Land use practices and soil regeneration

8. Man exploits arable land for the production of food and cash crops through farming and ranching or livestock raising. The soil of the farmland or rangeland consists of a top soil, varying in thickness from 3 to 12 inches depending on the soil type, climate and topography. The topsoil lie on a sub-soil which gradates into whatever parent rocks that form the substratum in that particular site. In terms of cultivable agricultural land, the most important part of the soil is the top soil which is a living ecosystem of organic matter, soil micro-organisms, air, moisture and mineral matter supporting the growth of the plant life of crops, grasslands, shrubs and forests growing on the soil. The top soil is a very precious natural resource: it

is almost non-renewable because if it is completely lost by soil erosion or degradation, soil scientists have estimated that it takes 100 to 300 years for the regeneration of one centimetre of soil from parent rocks. Hence there is an urgent need for the conservation and proper management of soils on arable lands for sustainable yield of the agricultural ecosystem (agro-ecosystem).

9. Subsistence agriculture as practised in developing countries through the system of shifting cultivation is considered as ecologically sustainable in that when soil fatigue is indicated in the farmland through reducing crop yields, the land is abandoned to fallow for the soil to recuperate, whilst another young forested area is cleared and burnt for farming in the next season. In the humid tropics, the fallow period can last for 10 to 15 years for the farmbush vegetation to succeed to young secondary forest, but in the subtropical savannah the fallow period is about five to seven years of tall savanna grasses and shrubs. In sem-arid and arid zones, with scattered scrub and low grass, not much is known about the practice of shifting cultivation and fallowing as described for the humid tropics.

10. Modern agriculture, on the other hand, demands a high input of energy in the form of farm machinery for large-scale monoculture plantations, heavy input of chemicals as fertilizers and pesticides, use of improved seeds and crop varieties as well as irrigation and drainage systems. UNEP's State of the Environment report for 1977, 3/ in dealing with the decreasing agricultural base on food production: land and soil loss, pointed out that modern agriculture is an artificial, unstable system subjected to major catastrophes characteristic of monoculture crops (e.g., pest outbreak). On the other hand, traditional shifting cultivation is a natural process restoring soil fertility in the same way as other natural systems such as rotation of crops using grass-crops-fallow system which was practised formerly in developed countries. Soil fatigue results from loss of organic humus and mineral salts generally; in the natural regeneration of soils in any ecosystem (forests or agricultural), biological recycling through the carbon cycle restores organic matter coupled with biogeochemical recycling through nitrogen, phosphorus and sulphur cycles to restore the mineral matter in soils. In short, the process of putrefaction and decomposition of waste materials, such as dead plants and animals by the soil micro-organs, return organic and inorganic materials back to the earth in a natural ecosystem and that encourages the regeneration of top soil.

11. Recent results of researches on improving soil conditions and agricultural practices for the optimum growth and maximum yield of crop plants, have recommended the practice of minimum tillage of the soil coupled with adequate modern agricultural inputs such as chemicals and improved seeds. In the temperate regions, the experience of the dust bowls in the Great Plains in the Mid-West of the United States during the 1930s was found to be due to

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3/ The State of the Environment: Selected Topics 1977. UNEP, Nairobi, Kenya.

unsuitable plowing and harrowing of the land causing widespread soil loss by wind erosion. Also the movement of heavy farm machinery on tropical lateritic soils which have a heavy clay content, causes compaction which, with leaching of soil chemicals from the top soil, hastens the formation of lateritic hard pans in the subsoil, common in degraded tropical soils. Hence the current practice of shifting cultivation can be gradually superceded by minimum tillage of the undisturbed soil, assisted by a layer of mulch or leguminous cover crop grown after crop harvesting to prevent soil erosion in the dry season when water is limiting.

Constraints on arable land use

12. Loss of existing agricultural productive land is due mainly to two factors, namely: (a) loss of non-agricultural uses such as urbanization, industrial development, construction of transportation infrastructure, recreation facilities, large dams and reservoirs; and (b) loss due to soil degradation and erosion. To compensate for soil loss in arable land, either virgin land from forested areas, swamplands and more marginal areas on hillslopes are cleared for cultivation or more intensive modern agricultural practices involving high inputs of energy and chemicals are employed on the remaining arable land to increase yield per unit area. OECD 4/ pointed out that whilst most of the potentially arable land in Europe and the USA are under cultivation now, the loss of existing cropland to non-agricultural purposes is about 3 to 5 million hectares annually. The OECD report also stated that soil erosion is already a serious problem in its member States and in the United States of America and Australia in particular about 50 per cent of cropland is already degraded by wind and soil erosion. In the humid tropics, subtropical, arid and semi-arid zones in Africa and other developing countries, the situation of soil degradation and soil erosion is worsened by the types of climate, topography and soils.

13. In a study carried out by FAO and UNESCO 5/ for a more accurate inventory of the world's soil resources and their potential for food and agricultural production, it was indicated that the main limitations of potentially arable land for agricultural use were drought, mineral stress, shallow soils, water excess and permafrost. In the case of Africa, 44 per cent of the total land area is occupied by deserts and soils under arid and semi-arid climates, compared to a world average of 28 per cent. Soils under mineral stress, which includes loss of soil fertility by denudation of nutrients and soil toxicity by pollution, accounts for 18 per cent (which is below the world's average of 23 per cent). Soils with shallow depths occuring on cleared hillslopes, savanna woodlands and on lateritic pans of deforested areas, form 13 per cent of the soil resources in Africa: again this is less than the world's average of 22 per cent. For excess water, only 9 per cent of water-logged soils exist in Africa which is about the same as the world's average of 10 per cent.

4/ Economic and Ecological Interdependence. OECD, 1982.

5/ FAO/UNESCO, Soil Map of the World, Paris, 1964-1974.

Permafrost is of little consequence in Africa, being limited to the ice-caps of the very high tropical mountains in East Africa. Finally, this leaves 16 per cent of the total land area of Africa with soil resources of no serious limitations, that is 460.5 million hectares of prime agricultural land.

Non-agricultural uses of arable lands

14. Using the FAO estimate that the non-agricultural land requirements to support a growing population is about 0.05 hectare (or 70.7 m by 70.7 m) per person, the following table 1 was compiled using the 1982 estimates of the medium-term variant for the total population as well as the projected rural/urban distribution of the estimated total population for the African situation.

Table 1: Population trends in ECA member States in relation to non-agricultural land requirements for urban areas

$(y = 146.64 + 49.25x^{2})$

Years	Population 6/ (y in millions)	Annual growth rate (in %)	Rural/urban distribution 6/	Non-agricultural land (in million ha) Total	Urban share (x)
1960	258.1	-	82:18	12.9	2.3
1965	291.6	2.5	79:21	14.6	3.1
1970	331.7	-	77:23	16.6	3.8
1975	380.2	3.1	74:26	19.0	4.9
1980	439.8	2.5	71:29	22.0	6.4
1985	507.8	2.9	68:32	25.4	8.1
1990	590.7	3.0	65:35	29.5	10.3
2000	811.4	2.7	58:42	40.5	17.0

6/ World Population Prospects: Estimates and projections as assessed in 1982. United Nations DIESA Population Studies No. 86. New York, 1985 (The total population excludes Namibia, Reunion and South Africa but includes ECA estimates for Djibouti, Sao Tome and Principe and the Seychelles).

15. With 1960 as a base, the table shows that the total population of ECA member States in Africa generally doubles in about 25-30 years at an average annual growth rate of 2.8 per cent. When the total population doubles, the total non-agricultural land requirements for rural and urban areas also doubles. In 1960, the urban share of the total population in Africa was only about 20 per cent. By the time the population doubled in 1985, the urban share had risen to about one-third of the total and it is fast approaching a 50:50 rural/urban ratio a few years after the year 2000 when the African population is doubling again. Thus, while the total non-agricultural land requirements is doubling with the population, the urban share due to urbanization is increasing at a faster rate of three to four times with the growth of the cities and towns. With this rate of loss of arable land to urban encroachment coupled with the projected loss of one-third of the world's arable land under cultivation at the rate of 7 to 10 million hectares annually by the end of the century, 7/ the reserve of potential arable land in Africa will be exhausted in no time at all.

16. Other factors contributing to the encroachment of arable land for non-agricultural uses which ought to be considered are as follows:

(a) Rural/urban migration is increasing in African countries as rural workers move to urban centres in search of better jobs, amenities and improved standard of living. Such migration impoverishes the agricultural labour base in the rural areas whilst creating slums and shanty towns in the suburban areas where cultivable land and rangelands for cattle usually located at the outskirts of African towns are lost to urban growth;

(b) The physical planning of resettlement schemes for refugees or for rural population removed from drought- or disease-stricken areas to more suitable sites in a country may be encroaching on prime agricultural land serving an existing community in the area. In addition to the settlement itself, the infrastructure for public utility services (roads, communication, water, electricity, services) usually pose a serious threat to farm lands;

(c) Mining activities, especially the exploitation of coal and other minerals in rich alluvial deposits where the soils are usually rich for agriculture will reduce the potential land area for cultivation. Rehabilitation of worked-out sites after open cast or deep mining can assist in alleviating the problem of loss of agricultural land; and

(d) Industrial siting and the location of treatment plants for the solid wastes and toxic effluents can pose a serious threat not only to human settlements and the health of the people but also indirectly to encroachment on and pollution of prime agricultural land, since the latter are generally located in valleys and on rich alluvial soils whilst the former - industries - are located on the less productive and generally upper land areas.

7/ FAO/UNEP, Guidelines for the Control of Soil Degradation, Rome, 1983.

Soil degradation in arable lands

17. By far the most serious loss of arable lands in the world is through soil degradation and soil erosion, which can account for 40-50 per cent of soil loss in the croplands of Europe, USA and Australia compared to a loss of less than 20 per cent of the arable land for non-agricultural purposes as pointed out earlier. The main factors responsible for soil degradation on arable lands in Africa are soil erosion, overcultivation, overgrazing, deforestation, desertification and the effects of drought, and improper irrigation schemes. Each of these factors will now be considered briefly in the following paragraphs.

18. Soil erosion results from the loss of the top soil by wind and/or by water. In the humid tropical forests and subtropical savanna grasslands, the normal heavy downpour in the wet season erodes the top soil when once the vegetation has been removed. If the soil is covered by annual or perennial crops, soil erosion is not as much as for bare exposed soils. In arid and semi-arid lands, wind erosion plays the major role through sandstorms and sand dune movement. However, whenever it rains, the flash floods do as much damage by water erosion of the patched top soil. Soil erosion is greatest on hillslopes where no contouring is practised on the farmlands as well as on deforested watersheds of rivers arising from the hills. The eroded soil is carried by run-off into streams and rivers as muddy water into the valley bottoms, lakes, dams or coastal areas where the generally heavy sediment load is deposited as silt. UNEP (1977) 8/ gave a few examples of newly constructed dams and reservoirs in developing countries silting up heavily and lasting only half of their lifetime because of soil erosion from the deforested watersheds.

19. Shifting cultivation also known as long-fallow agriculture, is a farming system of relatively short continuous cultivation period is followed by long periods of fallow as practised in tropical closed forests and open savanna woodlands. In the practice of shifting cultivation, population pressure can reduce the normal 10-15 year fallow period to about five years, preventing the recuperation of the top soil under fallow. Also, with the scarcity of good arable land due to factors mentioned elsewhere, marginal lands with thin soil or with excess water, dry soils, or soils on steep slopes, are converted to farmlands which show declining production over a few years. Brown (1979) 9/ mentioned a World Bank study carried out in Nigeria on the shortening of the fallow period with the addition of marginal land to the cropland base under shifting cultivation. The study pointed out a gradual decline in the

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8/ UNEP State of the Environment Report 1977, Nairobi, Kenya.

9/ Lester R. Brown (1979), Where has all the soil gone? Mazingira 10, 61-68 Pergamon Press, London.

productivity of the land as shown by decreasing yields of cereal. The trend had overriden the combined effects of advances in agricultural technology including chemical fertilizers, irrigation schemes and the use of improved varieties. Persistent cropping of land under inadequate fallow period under the traditional system of shifting cultivation prevents the normal succession of vegetation in the abandoned farmland towards a succession of forest regrowth with herbaceous shrubs on to young, fast-growing, heliophilic secondary forest trees, or the normal tall savanna grasses in savanna woodland areas. Instead, as the top soil wears thin with over-cultivation, the parent rock of granite is exposed in places, and most of the exposed soil is leached of its mineral salts and a lateritic hardpan is formed in the subsoil. With no seed bank remaining on the impoverished subsoil, poor grasslands of Imperata species take over with their tough rhizomatous roots which are very hard to eradicate in trying to rehabilitate the denuded land into farmland again. To compensate for reduced fallowing under shifting cultivation, experimental studies are showing that semi-permanent cultivation with short grass/legume fallows or the use of mineral fertilizers, the conservation of organic farm refuse material and mixed farming practices, can maintain and even increase subsistence crop yields. A FAO/UNEP study of shifting cultivation practices in 90 tropical countries worldwide has estimated that 61.7 million hectares of closed forests and 104.4 million hectares of open savanna woodlands in tropical Africa are under shifting cultivation as defined above, and that the rate of increase of this forest fallow areas by encroachment of farmland was 1.4 per cent in Africa compared to a global 1.25 per cent in the tropical world. 10/

20. Overgrazing: FAO estimated 11/ that Africa has 690 million hectares of permanent pasture out of a world total of 30.5 million km^2, in the form of natural vegetation suitable for cattle grazing and ranching. In Africa, about half of such grazing lands occur in the sub-humid savannas, the tropical montane grasslands, and as short grasses on seasonal floodplains; the remainder occurs in the aridlands of the Sudano-Sahelian woodlands. In the aridlands where water is a limiting factor, boreholes are dug as watering points for cattle. However, serious problems of land degradation arises from tramping of the grass by the cattle around the boreholes if the spacing between them is not adequate and if the cattle-carrying capacity of the rangeland is exceeded. Improved veterinary services, including cattle vaccination programmes and also favourable (non-drought) years, cause the cattle population to increase in aridlands beyond the carrying capacity. UNEP (1977) pointed out that in the Kordofan province of the Sudan on the fringe of the Sahara desert, domestic livestock increased fourfold between 1957 and 1966 at the onset of the Sahelian drought. 12/ Brown (1976) 13/ pointed out that as human population increases

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10/ J.P. Lanly, Defining and Measuring Shifting Cultivation. UNASYLVA, vol. 37, pp. 17-21, FAO, Rome.

11/ FAO Environment Paper No. 1 - Natural Resources and the Human Environment for Food and Agriculture, 1980.

12/ UNEP, State of the Environment Report 1977, Nairobi, Kenya.

13/ Lester R. Brown, Patricia L. McGrath and Bruce Stokes, 1976, Twenty-Two Dimensions of the Population Problem. Worldwatch Paper 5, Worldwatch Institute, USA.

in poor countries, the livestock population also increases commensurately to expand draught power for farming, food supplies, family wealth and security. In such marginal aridland areas, this leads to overgrazing, degradation and abandonment of the rangeland as soil erosion by wind and water takes over. He cited numerous areas in North Africa which were once the fertile granary of the Roman Empire, and in Mali, the Niger, the Sudan and Ethiopia where the current annual population growth of about 3 per cent is causing concern. Finally, an examination of recent ECA estimates 14/ of the annual growth rates of population for 1980-1985, shows that the Libyan Arab Jamahiriya (3.7) and Algeria (3.6) North of the Sahara, Mali (2.9), Mauritania (3.6), the Niger (3.0), Somalia (2.9), Kenya (4.2) and the United Republic of Tanzania (3.2) in the Sudano-Sahelian zone, and Swaziland (3.8) and Botswana (3.0) in Southern Africa, already have high annual population growth rates of 3 to 4 per cent (shown in brackets). On the basis of the above theory, overgrazing will get worse in these countries, some of which already have highly denuded areas, as population pressure increases by the end of the decade, and as nomadic pastoralism is superceded by sedentary agriculture.

21. Irrigation schemes: Although only about 10 per cent of cultivable lands in Africa is under irrigation, it has become a proven necessity in arid and semi-arid lands to supplement the limited and unreliable rain-fed agriculture in those zones. In planning an irrigation scheme in aridlands, groundwater aquifers or large rivers and lakes have to be used as the source for freshwater because irrigation can consume as much as 70 per cent of the total water used in agriculture for livestock production, for domestic rural and urban use and for industrial and mining purposes in any country. Also, all irrigation schemes should be linked with reclamation methods to remove or prevent salinization, alkinization and waterlogging conditions which have damaged half of the irrigated lands in the world already. A multidisciplinary team of hydrogeologists, soil scientists and morphologists, and water engineers should carry out the large-scale field surveys necessary for an irrigation scheme in order to prepare several kinds of maps of the area, with the assistance of aerial photographs and satellite images. The first set of maps for the area to be irrigated should show contouring, the physical features, vegetation, soil types, geological structures and human settlements infrastructures. Then several drillings and wide pits are dug in the area in order to construct maps indicating the other factors, such as the thicknesses of the soil and the aeration/saturation zones, impermeable layers, depth of groundwater aquifers, infiltration parameters of the soil from the aeration zone, seasonal rise and fall of the water table, dissolved solid (salt) content of the soil. Then finally a series of laboratory tests are made on soil samples collected from various areas and profiles at the site to be irrigated to determine the range of biophysical soil properties, such as structure, pH, texture (for classification into loamy, sandy or clayey), moisture content, aeration and chemical composition of the soil solution. These common soil

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14/ Population Trends in ECA member States 1970-2000. ECA Population Studies Series No. 4 of 1983.

properties relate to the fertility or the degradation status of the particular top soil. For the construction of the irrigation canals, laboratory tests are carried out on samples from boreholes and pits for the engineering properties of the soil such as porosity, salt content, volume/weight ratios, moisture content; granulometric analysis at borings down to several metres, petrological analysis for different rock types, plasticity of the soil for its water budget, the shearing strength for the stability of the canal walls, the swelling/soaking ratios for deformities and subsidences in the canal system and the cohesiveness of the soil for its infiltration ratio. It is necessary to point out these technical details 15/ on the establishment of irrigation systems in order to emphasize that unless these studies are properly carried out and evaluated, African countries will experience soil denudation of the limited arable land in their arid and semi-arid regions through salinization and waterlogging, at a time when the necessary financial and technical resources to reclaim the land are not even available.

22. Deforestation is mainly due to the fuelwood energy problem and the practice of shifting cultivation. Tropical forest clearing is proceeding at a faster rate than the establishment of tree plantations to release the pressure on the demand for industrial timber and domestic fuelwood and charcoal. The replacement ratio, according to a FAO/UNEP study on tropical forests, 16/ is the area of forest trees planted as plantation forest compared to the area cleared by deforestation. For the closed and open tropical forests in Africa, the ratio is 1 to 29 which is the lowest in the world (cf. tropical America is 1 to 10.5 and tropical Asia is 1 to 4.5). The situation is very serious because of the very high rate of deforestation caused by the dense population in the West African forest zones, which results in soil erosion with the loss of the useful top soil by run-off during rain storms into muddy streams and rivers. In the savanna woodlands of the Sudano-Sahelian zones in Africa, the main cause of deforestation is the clearing of the vegetation to supply firewood and charcoal as sources of energy. This is seriously contributing towards encroachment of desert sands on productive agricultural land in the areas. It is estimated that 75 per cent of the population in developing countries rely on firewood and charcoal as their main source of energy for cooking and for heating especially at night in the arid zones. The ever-widening circle of treeless zones (10-30 km wide) around urban centres in the Sudano-Sahelian zone is now a familiar phenomenon and an urgent environmental problem in Africa. Unless steps are taken to make use of non-conventional sources of energy such as biogas, solar and wind energy as well as establishing more tree plantations as village woodlots, energy farms, the situation of soil degradation after forest clearing may be out of control by the turn of the century. Another serious factor for soil degradation is the use of inappropriate technology in tropical farming practices. Experience

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15/ ECA/USSR Seminar on "Problems of water resources Development in Arid Zones", Moscow, 1981.

16/ FAO/UNEP Tropical Forest Resources Assessment, 1981.

in the use of sophisticated agricultural machinery after the conversion of forested land into large-scale, permanent farmlands for commercial crops, has shown that this farming practice is harmful to the laterite soils in tropical Africa. Monoculture of annuals does not maintain the soil structure and the soil-water regime, and the pattern of biogeochemical cycling of minerals in tropical forests soils are put off balance. There is an urgent need to put into practice the results of research work carried out on improved tropical farming practices by research institutions such as the International Institute of Tropical Agriculture (IITA) in Ibadan, Nigeria and the International Livestock Centre for Africa (ILCA) in Addis Ababa, Ethiopia.

23. Desertification and drought the creeping of desert sands on arable lands, estimated at the rate of 7-10 km per year, is most evident on human settlements within the Sudano-Sahelian zone and in the Kalahari Desert area in Southern Africa. Desert encroachment is facilitated by movement of sand dunes on desert fringes and in coastal areas, by the removal of the protective trees acting as windbreaks or shelterbelts for firewood, and by soil erosion and loss in dust storms enhanced by prolonged drought. It is also noted that prolonged drought in pastoral areas leads to migration of people and cattle to marginal arable areas with corresponding degradation due to increased pressure in the drought-stricken areas. The process of desertification is not only confined to the arid and semi-arid zones, but can also be found in the sub-humid zones. In aridlands, the climate, soils and vegetation enhance the susceptibility of the area to a disruption of the fragile ecosystem through farming, cattle grazing and removal of the native vegetation for firewood. Reports by ECA 17/ and the seven-year review by UNEP 18/ have shown that climatic variability experienced in prolonged drought, coupled with human and cattle population pressures, can cause the sub-humid regions in Africa to assume desert-like conditions. This is shown by the loss of the vegetation, the degradation of the soil, increased incidence of bushfires on plantation crops and creeping of the desert sands on farmlands.

24. The discussion which followed the presentation by the ECA secretariat centred around the following themes:

(a) What is potentially arable land? The experts agreed that it should include all land surface at present under natural vegetation which, if removed, would render the soil available for agricultural cultivation. This also includes natural grasslands for grazing, especially in the arid lands;

17/ E/ECA/CM.10/23, Report of the Scientific Round Table on the Climatic Situation and Drought in Africa, May 1984, Addis Ababa.

18/ UNEP/GC.12/9, General Assessment of Progress in the Implementation of the Plan of Action to Combat Desertification, 1977-1984. Report of the Executive Director of UNEP, Nairobi, Kenya.

(b) The conflict between land users in dealing with the problem of encroachment on arable land: Several experts gave examples of migrating herdsmen (Fulani) degrading pastureland through overgrazing so that in areas where mixed-farming is practised, a conflict arises between the farmers and the herdsmen. Another dimension to the problem raised was the effort of national forestry department workers to rehabilitate degraded lands through tree planting and other soil conservation measures as migrant cattle undermines their efforts. The experts agreed that in solving such conflicts, community participation and the use of extension workers should be encouraged in controlling overgrazing, in re-afforestation projects and in executing soil conservation measures on degraded communal lands under shifting cultivation;

(c) The expert from UNESCO pointed out that under its Man and the Biosphere Programme (MAB), biosphere reserves consist of core areas conserved and protected to retain the genetic rsources they contain as a reference point vis-a-vis a buffer zone that could serve for experiments related to land use. He stressed that soil conservation for the prevention of encroachment on arable land should be treated likewise through rational utilization of a very scarce natural resource;

(d) The experts placed emphasis on the dissemination of information on soil degradation between African countries and international organizations through the establishment of focal points within the countries, updating and drawing of country maps to indicate encroachment on arable lands by urbanization as well as by loss through soil degradation (see FAO World Soil Map 1964-1974), and the establishment of national land use survey and planning; and

(e) The experts felt that there was need to search for alternatives to the traditional system of shifting cultivation and to deforestation. It was noted that African regional research organizations such as the International Institute for Tropical Agriculture (IITA) in Ibadan and the International Livestock Centre for Africa (ILCA) in Addis Ababa, both of which were invited to this meeting, have provided research results indicating that shifting cultivation can be replaced by minimum to no tillage cultivation, supplemented by weeding and fodder cropping.

III. COUNTRY REPORTS BY AFRICAN EXPERTS

NIGERIA

The problem of encroachment on arable land in Nigeria

25. The expert from Nigeria in his country report said that Nigeria has a total land area of approximately 92.4 million ha^2 with a population of 80 million people. The livestock population of about 58 million is mainly concentrated in the five northern states affected by desert encroachment in the Guinea and Sudan savanna zones. He said that at least 70 per cent of the total land surface is cultivable and this exists mainly in the savanna regions which constitute 80 per cent of the total land area. Only 10 per cent represents reserved forest land but actual productive (commercial) forest is only 2 per cent.

26. He stated that activities or factors which constitute encroachment on arable land include (a) natural factors, such as desertification and drought, and (b) factors which induce or accelerate soil degradation, such as urbanization, physical development, farming activities and deforestation.

27. Mechanization of land preparation and construction of irrigation dams, though essential for development of agriculture, have been identified as some of the major causes of soil displacement and/or human resettlement and soil loss. Although the land use decree of 1978 tried to regulate land allocation particularly for agricultural production, the land use policy is not clearly defined and there is yet to be a land use plan.

28. He pointed out that a number of international organizations such as FAO, the United Nations Sudano-Sahelian Office, the International Bank for Reconstruction and Development, IITA, have shown interest in one form or the other in solving the problem of desertification and soil erosion through assistance in projects operated at national level or through research activities. Efforts are minimal in relation to the size of the problems involved.

29. The report recommends, among other things, the institution of national and interregional bodies for generating and disseminating information as well as for working out programmes of action intended to combat the problems. An interdisciplinary approach is recommended, as isolated efforts have tended to emphasize areas of conflicts rather than linkages in land use.

Discussion

30. The experts made the following points in discussing the country report of the participant from Nigeria:

(a) On land use policy, it was explained that in Nigeria, the Federal Government decree of 1978 vested the ownership of all lands in the State Governments who held the land in trust for the people. While the Federal

Government is responsible for formulating land use policies, the State Government does the implementation of such policies to regulate the use of the land. The expert from UNESCO pointed out that the Man and the Biosphere (MAB) programme was encouraging the setting up of subregional and national bodies such as the Institute of Tropical Ecology in Uganda for the study and application of conservation measures, hence one of the recommendations of the expert from Nigeria to establish such a body for soil degradation, was timely;

(b) On the encroachment of urbanization, the expert from Nigeria pointed out that since Nigeria attained independence, the growth of urban centres and regional capitals has been phenomenal, from 4 to 12 in 1967, and to 19 in 1976, excluding the new Federal capital territory; 14 new airports had also been constructed, displacing farmers from arable lands;

(c) The problem of soil erosion in Nigeria has been examined in a FAO study in 1980 by Nigerian consultants. This was followed by the setting up of a Land Resources Department separate from the Forestry Department. The new department had been studying soil degradation in Anambra and Imo States where soil erosion gullies are about a 100 m. deep, impeding highway construction, causing huge landslides on arable lands and similar calamities. The experts agreed that the problem of soil degradation should be addressed from an integrated approach to environment and development for developing national plans of action for soil conservation;

(d) On co-ordination of activities to combat soil degradation, the expert from Nigeria informed the meeting of the work of the Nigerian Conservation Foundation (NCF) as a respected non-governmental organization with international affiliations to World Weather Watch which can approach the Government directly on environmental issues. Some of the activities of the NCF have relevance to the United Nations Sudano-Sahelian Office's (UNSO) project on the improvement and adaptation of cooking stoves in relation to the socio-cultural aspects of the user community, development of environmental consciousness in the public sector, and co-ordination of national environmental activities between government departments and non-governmental bodies in areas such as planting campaigns and World Environment Day activities;

(e) The experts agreed that, in order to assist African Governments in developing national co-ordinating mechanisms, a network on soils management in Africa should be established. The Network should involve government departments, universities, non-governmental organizations involved in water resources management, soil degradation and non-agricultural land uses of arable lands. The network could be a mechanism for the exchange of information on alternatives to shifting cultivation, such as alley-cropping for growing agricultural food crops between rows of fodder trees and leguminous cover; on the effect of mechanization of humid forest soils and on savanna woodland soils; and on the suitability of new tree species for shelterbelts in desertification control.

The prevention of land degradation in Côte d'Ivoire

31. The expert from Côte d'Ivoire reported on the prevention of soil degradation in his country. He said that his country has an area of 3-2,365 km^2 made up of cultivable land (76 per cent), 10 per cent of which is cultivated; forest lands (11 per cent); national parks and reserves (6 per cent); and uncultivable land (7 per cent).

32. He continued by stating that the measures undertaken had the objective of reducing the rate of agricultural land "consumption" and to maintain their fertility so as to stabilize agriculture. The measures, he said, were also to improve on the productivity of the land. He said that action was being taken to effectively introduce a land law that would discourage anarchical occupation of lands and to encourage, at the same time, the stabilization of land exploitation. A systematic inventory of land and water resources was being carried out and an agro-sylvo-pastoral plan was also being drawn up for the best uses of these resources.

33. The analysis of the results obtained by research and development, he said, showed that intensification of the area now under cultivation had increased production threefold. Mechanization had to be rationally managed to protect the land from the risks of erosion which increased with mechanized tilling. Action was also being taken to fight against bushfires. This included mass education sensibilization, fire protection rules and sanctions. There was also a more effective integration of agriculture and livestock by-products, agro-pastoral development and animal husbandry under palm trees. Land in valley bottoms and flood plains which were abondoned because of health reasons (onchorcerciasis zone) or cultival beliefs, were now being developed as good agricultural lands. There was also the development of irrigation, the rationalization of forest exploitation and the application of a strict reafforestation policy. These activities he concluded, were recently started so that it was not possible to evaluate their impact as to how they will improve agricultural production.

Discussion

34. In reply to a question concerning the type of shifting cultivation and multiple land use practices where both cash and food crops are sown together in the cleared lands, leaving the perennial cash crop after harvesting the annual food crop, the expert from Côte d'Ivoire replied that farmers producing oil palms, cocoa, or coffee, could sell their produce whilst the same land is being used for food crops. Food crops, he explained, were usually planted during the first year of clearing the land and the cash crops are planted in the following year. The farmers in forest areas, he said, usually gave priority to export cash crops while in the savanna they planted mainly food crops like yams, cassava and vegetables.

35. In reply to a question on the extent of intensive farming and the type of soil management practices being carried out, the expert pointed out that the fertilizers and compost manure were used under this improved shifting

cultivation. Regarding the absence in his presentation of a pricing policy influencing land use practices, the expert from Côte d'Ivoire said that the matter was now being examined by the Government. A point was raised about mechanization being one of the causes of desertification and that care should be taken as to its application on tropical soils. It was noted that while a fair amount of land is still available for cultivation, the main problem in forest zones now is that of deforestation.

Prevention of encroachment on arable land in the Sudan

36. The expert from the Sudan reported that prevention of encroachment on arable and forests land in the Sudan started in 1917 and 1942 respectively by the Departments of Soil Conservation and Forestry, when the country was ruled by Britain. Nowadays, due to increasing population pressure and their increasing needs for food crops and cash crops, the system of cultivation has changed from the traditional shifting cultivation to modern mechanized farming. An area of 1,000 to 1,500 acres of bushland is generally allotted to a single merchant-farmer who uproots the vegetation and burns everything in order to plant food or cash crops for only three to seven years. The farmland is then left bare and the ground exposed to further wind erosion and runoff from flash floods. In this way he said, more than 4 million acres of forest land has been degraded as completely non-productive land in a period of 15 years.

37. Simultaneously, herders who practised transhumance migration to search for fresh grass and water and to escape biting flies and mud hazards were forced and pushed continuously northwards to face their fate in marginal lands with limited vegetative cover and no surface water. The situation changed for the worse when deep borewells were dug to provide unlimited water supply in the marginal lands in the semi-desert areas. Efforts were now being exerted for restocking and reafforestation of marginal lands but this could not cope with the very fast rate of destruction which is still going on.

38. In one region (Kordofan), 70,000 acres were distributed last year for mechanized farming; the only measure taken was that every farmer had to leave a tree belt 20 m. wide which divides his farm into four sections (6 per cent of the 1,000 acre farm had to be left under the bush). Every farmer in the mechanized areas had to restock a similar area in future with gum trees if the area are already denuded. Efforts were also exerted with the help of the United Nations organizations, such as UNDP, UNSO and FAO to restock the degraded areas and encourage community forests.

Discussion

39. During the discussion that followed, two main issues were raised: that of the modes of shifting cultivation in the Sudan and sand dune fixation for desertification control. The problem was the non-availability of data on encroachment by sand dunes in the Kordofan region and the lack of data on degradation of land around the villages.

40. The expert from the Sudan explained that shifting cultivation was still being practised particularly for the production of food crops in the humid savanna woodlands. Concerning sand dune fixation, farmers were usually encouraged to surround their farms with a 20 m. wide area of natural vegetation or Acacia senegaleasis. They had also introduced a method of enclosing dune-prone areas with trees and barbed wire but this proved to be very expensive. Degraded areas around villages was due mainly to shifting cultivation, fuelwood cutting, overgrazing with overstocking as a sign of wealth and influence.

41. Concerning jojoba trials, he informed the meeting that they were successful as orchard shrubs at first, but propagation for desertification control had not yet succeeded. Trials with mesquite shrubs and Acacia species for sand dune fixation around villages and along rivers were more successful.

42. The meeting was also informed by the UNEP representative of a series of seminars that were being planned on sand dune fixation, using the experience that was gained in the Sudan, Somalia, Mauritania as well as from the workshops in China and the USSR, for the establishment of a network of sand dune activities in Africa. The expert from FAO pointed out that from experience in Russia sand dunes comprising of schists can form good arable soils in six to seven years after being fixed. But, in the Sahara Desert, fixed or stabilized sand dunes do not easily form good soil because the sand is quartz which does not easily decompose. Hence the economics of sand dune fixation in Africa should be of major concern in that sand dunes are stabilized to prevent moving sand from engulfing highways, telecommunication lines and human settlements.

IV. INTERNATIONAL REVIEW AND ONGOING ACTIVITIES

Cultivating climatically marginal lands: drought follows the plough by UNEP consultant

43. A UNEP consultant, Dr. Michael H. Glantz, said that as arid and semi-arid lands marginal to agricultural production become increasingly put under the plow, the probability that those activities will be adversely affected by drought (and bring about desertification)will increase. Thus, in the future, we will be hearing more about droughts than in the past, not necessarily because precipitation patterns in those areas will have changed as a result of these agricultural practices, but because the newly imposed activities will require (in the long term) a greater water supply than such arid and semi-arid lands can provide.

44. This report provides specific examples from north-east Brazil, the West African Sahel, Kenya and the USA Great Plains. It also discusses the problems associated with different views about what drought is about, what drought does in terms of its societal and environmental effects. A summary of factors categorized as "push" and "pull" factors provides some reason for the encroachment of human activities onto marginally arable land and on rangelands.

45. Using the data provided in the case studies, it is concluded that, given the rainfall statistics of these marginal areas, the probability of occurrence of meteorological and perhaps agricultural drought can be estimated. Assuming that historical climate characteristics of a region have not changed over time (about which there is much application) and are therefore applicable to the future, one can determine the levels of risk that would accompany different human activities in the climatically marginal areas.

Discussion

46. The Chairman of the meeting thanked the expert for the comprehensiveness of the paper and for the new insight the paper has provided into the concept of "drought follows the plough".

47. Commenting on the role of mechanization, the expert explained that mechanization could play both a negative and a positive role in agricultural output, but that this paper stressed the negative aspect because other experts have only looked at the positive side of the issue.

48. The representative of the ECA secretariat said that the cultural aspect of drought should have been stressed. The expert agreed that the cultural considerations should be addressed by the meeting.

49. One expert wanted to know what role, if any, did the present space technology play in the African changing climate? It was then observed that space technology perhaps plays a very small part in the new changing patterns of the world or African climate.

50. On the issue of the statement "drought follows the plough", the expert explained that it would have been more appropriate to say "agricultural drought follows the plow" because this implies that agricultural activities in marginal areas can heighten the risk to environmental degradation during periods of moisture stress.

Processes of land degradation and perspective of prevention of encroachment on arable lands in Africa by FAO expert

51. The FAO expert identified five processes leading to land degradation and desertification considered in the paper as: water action, wind action, salinization, animal pressure and population pressure on the land. In addition, the growing period of the land status on which the natural and induced processes acted is also taken into consideration, as that period of the year when rainfed agriculture facilitates the completion of the life cycle of any crop planted in the area.

52. African countries have been grouped according to their climatic conditions in the following way:

(a) Dry countries in which the zones without a growing period is more than 80 per cent of the total land area;

(b) Intermediate or sub-humid countries in which the zones without a growing period occur on 0.1 and 50 per cent of the total land; and

(c) Humid countries in which the zones without a growing period do not exist.

53. The interpretation of the data concerning the processes of degradation and the data concerning the interrelationships between the arable land, permanent pastures, forest and woodland, and other lands have been made according to this grouping.

54. It was found that the effects of degradation processes change from one group of countries to another and the inherent susceptibility of the land to degradation is influenced to different degrees by social activities within the various countries. Land degradation is the result of the interaction of natural processes and of processes due to human and animal pressures. But only through man's intervention can land degradation be slowed down and stopped. In order to increase the efficiency of the human interventions, the decision makers must pay attention to the natural conditions and the processes that lead to land degradation. The data presented was interpreted to demonstrate that encroachment on arable land is clearly a part of environmental degradation.

Discussion

55. The main discussion area was on the omission of a number of African countries from the lists given of countries affected in various ways (from slight, moderate, severe to very severe) by each of the five processes of land degradation and desertification which are favouring encroachment on arable lands. Several experts pointed out that countries such as Burundi, Nigeria, Rwanda and Somalia are severely affected by more than one of the factors: wind erosion, water erosion, salinization, animal pressure and population pressure. It was noted that Nigeria was grouped in the humid zones because the zones without growing periods do not exist, even though above latitude 12° North in Nigeria, aridlands with sand dunes in a vast treeless landscape were quite common.

56. The experts expressed the view that the data showing that the carrying capacity of the land for cattle in the three major bioclimatic groupings in Africa identified by the FAO expert exceeded the desirable limits would have more significance if such data was first done on a country basis and, secondly, according to the different ecological/vegetation zones in each African country.

Reflections on the prevention of encroachment on arable lands in Africa by UNESCO expert

57. The expert from UNESCO said that overcropping depleted the nutrients in circulation in the soil which cannot be further replenished by natural processes or by the addition of fertilizers. Pastures in most parts of the

Africa region are grazed so heavily that palatable species can no more sustain themselves. Harvested organisms in the fragile ecosystems are depleted beyond optimal sustainable yield. The only land surface left for meaningful agriculture is only 16 per cent of the continent's entire size. The system is no longer efficient; it is, rather, on a down-hill process of ecological degradation.

58. He emphasized that since the trend was precipitated by man, in a system in which he himself is centrally enmeshed in an intricate ecological disaster, the process of change can only come through an ecological therapy also involving man. All the salient parameters of land degradation have to be diagnosed in their intricate interrelationships; and the chances of survival carefully and critically appraised before any reliable treatment can be offered.

59. The expert said that UNESCO's Man and the Biosphere (MAB) programme was collaborating with United Nations agencies (FAO, UNSO) and with non-governmental organizations (International Union for Conservation of Nature and International Council of Scientific Unions) who possess the knowledge, the experience and the expertise as well as the tools to participate in the treatment of saving Africa's arable lands. He said that MAB had a network system of pilot projects on a regional and global level and about 40 National Committees in Africa which give as their priorities for action, the establishment of biosphere reserves and environmental training through three-month courses run at various international centres such as Dresden and Montpellier. Finally, he gave details of UNESCO's MAB field project - Integrated Project on Arid Lands (IPAL) in Tunisia and northern Kenya as well as the humid tropical forests pilot projects at Tai Reserve (Côte d'Ivoire), Omo Forest (Nigeria) and Luki (Zaire).

Activities on prevention of encroachment on arable lands by UNEP expert

60. On behalf of the Executive Director, the representative of UNEP expressed the support of his organization for the meeting and thanked ECA for convening it. He noted that UNEP attaches great importance to the problem of encroachment on arable land which is a very serious one and needs to be understood and dealt with better. He went on to observe that desertification and the problem of encroachment on arable land are intertwined and that they are both developmental and environmental problems.

61. Referring to the findings of the general assessment on progress on implementation of the Plan of Action to Combat Desertification, conducted by UNEP in 1983-1984, he said that the global threat of desertification, far from diminishing, has grown over the past seven years since the United Nations Conference on Desertification. He went on to inform the meeting about UNEP's activities relating to encroachment on arable lands being carried out under different programmes, such as (a) desertification control; (b) soils; and (c) environmental monitoring programmes.

62. The UNEP representative described in detail some major assistance activities including training, formulation of national plans and programmes to combat desertification and implementation of projects in various aspects of desertification control such as sand dune fixation, afforestation, rangeland management and soil conservation, being carried out under desertification control programme. In addition to these activities, UNEP is implementing programmes on soils, and within the Global Environmental Monitoring (GEM) service under which many activities of direct relevance to the prevention of encroachment on arable land are carried out.

63. The representative of UNEP concluded his statement by noting that many of the activities described are carried out in co-operation and collaboration with other United Nations organizations and agencies including the regional commissions. He stressed the necessity to involve NCOs in efforts to combat desertification and encroachment on arable lands and pledged UNEP's continued support within the limits of available resources for activities aimed at prevention of encroachment on arable land.

Review of ongoing related activities of FAO

64. FAO activities of the Soil Resources Management and Conservation Services of the Land and Water Development Division are linked with the theme of the ECA expert consultation on encroachment on arable land. In this connection, the expert gave a brief review of the FAO activities which are generally carried out in collaboration with other United Nations agencies and country specialists.

(a) Activity at the global level

(i) Soil Map of the World: 1:5 M scale (1964 to 1974)

- need for updating the map now, hence the current activity is improving the legend;

- computerizing and digitizing of the new information at 1:1 M scale;

- obtaining this information at the national level, but not to publish a new map.

(ii) Map of Desertification Control

(iii) World Soil Charter

- already mentioned in his report.

(b) Activities concerning developing countries

(i) Agro-ecological Zones (map at 1:10 M and report);

(ii) Potential Population Supporting Capacities (map at 1:10 M and report);

(iii) Soil Degradation in Africa North of the Equator; (map at 1:5 M and report).

(c) Methodologies and guidelines on:

(i) agro-ecological zones;

(ii) potential population-supporting capacity;

(iii) land use planning;

(iv) assessing soil degradation;

(v) assessing and mapping of desertification;

(vi) land suitability for rainfed agriculture;

(vii) land suitability for irrigation.

(d) Field work (country and regional agricultural development projects) UNDP/FAO projects or donor countries/FAO projects in the following domains:

(i) creation of soil services;

(ii) soil inventory and mapping;

(iii) equipment for soils laboratories;

(iv) land evaluation;

(v) soil conservation;

(vi) soil fertility and use of fertilizers;

(vii) reclamation of saline soils;

(viii) training programmes (separately or included in the above activities).

(e) Technical co-operation projects (for the urgent solving of a specific problem). Similar activities are carried out by all other divisions and services of FAO.

Discussions on activities of the United Nations

65. The Chairman observed that there is a need to establish a working relationship between the UNESCO - MAB programme and the agriculturalists. He said that since MAB was concerned with the proper management of the

ecosystems and whereas the interest of the agriculturalists was on emphasis for greater agricultural output, as was noted from the experience of his country - Nigeria. The agriculturalists should work together with the foresters, who are mainly concerned with conservation, in sharing information and collaborating to deal with the problem of encroachment on arable land to prevent soil degradation and to promote the protection of the environment.

66. A member of the ECA secretariat wanted clarification on the relationship of the UNESCO projects listed and problem of encroachment on arable land. The UNESCO expert noted that the pilot projects such as the Integrated Project on Arid lands (IPAL) and others under the MAB programme are concerned with human activities as these activities effect the ecosystems. Therefore, most of the funded projects on the impact of human activities on various ecosystems were directly concerned with the prevention of degradation and encroachment on arable lands in Africa because of the aim of checking adverse impacts on the land. He further stated that a new project of educational character similar to the IPAL project was being planned for the Southern Africa Development Co-ordination Conference countries by UNESCO and UNEP.

67. The experts agreed that the problem of encroachment on arable lands in Africa should be approached in a multidisciplinary manner involving the incorporation of environmental concerns for land and soil conservation into the development processes of cultivation of arable lands, improvement of soils and better water management for increased food production in Africa. The experts noted that environmental problems have to reach crisis level before governments can give them the priority they deserve for incorporation into national development planning, as it is politically expedient to take the short-term gains by disregarding environmental measures as against the long-term costs and benefits of incorporating environmental concerns into development activities.

V. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

68. The expert consultation on the prevention of encroachment on arable land in Africa has proved that the problem is very complex, the solution of which requires a multidisciplinary approach. The experts noted the specificity of encroachment on arable land in the dry and humid conditions expressed by the intensity of the various processes and by the efficiency for reclamation. It was recognized that the data does not exist to quantify encroachment on arable land. In summary, the problem was diagnosed as follows:

(a) Status of potentially arable land: In spite of the euphoristic situation that only 23 per cent of potentially available arable land in Africa is now under cultivation in the continent, the situation of encroachment on arable land in individual African countries calls for comprehensive land use planning as most of the prime agricultural land has been used up, especially in the smaller African countries;

(b) Conflict between farmers, herdsmen and foresters: The experts agreed that potentially available arable land should include all land now under natural vegetation cover such as forests, grasslands which, if removed, can render the land available for agricultural purposes. As such, they appreciated the conflicts and tensions existing between farmers, herdsmen (especially nomadic cattle grazers) and the foresters whose main concern is conservation;

(c) Non-agricultural land uses: Another conflict realized in the land use situation in Africa is that involving the use of the land for non-agricultural purposes. Most African Governments hold the land in trust for the people and they acquire land for urbanization, for developing transport and communication networks (highways, electric pylons, airports), for industrial complexes, for large dams and so on. All of these involve the use of prime agricultural land in valleys and plains, hence development appears to clash with environmental concerns because subsistence farmers are then forced to use marginal lands;

(d) Causes of soil degradation: The experts agreed that the main causes of encroachment on arable land are factors resulting in soil degradation in existing prime agricultural land, such as soil erosion from wind and water; intensive shifting cultivation without adequate fallow due to human population pressure; mechanization on unsuitable tropical soils; overgrazing and overstocking beyond the carrying capacity of aridlands; deforestation and removal of vegetation cover for fuelwood; creeping of the desert sands over farmland and human settlements; and, inefficient irrigation practices leading to salinization and waterlogging;

(e) Alternatives to shifting cultivation: The experts noted that agricultural research work in the regional tropical institutions was providing better alternatives to the traditional system of shifting cultivation in tropical forested lands. In several instances, the natural forest vegetation is replaced by cash crop trees (oil palm, coffee, cocoa, gum arabic) during the three to four year period of traditional cropping for food crops, so that during fallowing, the soil is never exposed for any length of time to water and wind erosion;

(f) Modern agricultural techniques: The experts noted that there is desire by most African Governments to increase rapidly their levels of food production, which can only be achieved through mechanization. It was noted that intensive modern agriculture involving heavy farm machinery and the use of chemical inputs such as fertilizers, pesticides and herbicides was more suitable for tropical soils in savanna woodlands and in river valleys, but not so good for tropical forest soils whose mineral content and thinness are in dynamic equilibrium with the standing forest cover. Experiences in African countries indicate that farm mechanization is successful for cropping annual and biennial food crops such as cereals suitable to sub-humid savanna climate;

(g) Sand dune fixation: The experts agreed that the problems of encroachment on arable land were intricately linked with the processes of

desertification especially at the initial stage of dust storms with loss of the top soils of arable lands by wind erosion, followed by massive sand dune movements engulfing farmlands and villages. Hence more emphasis should be put on sand dune stabilization and fixation by physical means as well as by using suitable plant species of grasses and desert shrubs such as mesquite.

Recommendations

69. To prevent the encroachment on arable lands in Africa, the Expert Consultation recommended that:

At the national level

(a) Promote the dissemination and exchange of information on soil degradation control measures; on non-agricultural land use; on improvement in mechanized farming systems, methods and techniques; on alternatives to shifting cultivation and on sand dune stabilization techniques;

(b) Carry out national land use survey for an inventory of land use practices and for monitoring soil degradation in existing arable lands in order to improve on land use planning, updating of land use and soil maps of the country and developing better land use and soils policy;

(c) Promote research work for the improvement of traditional shifting cultivation and of heavy farm mechanization and chemical inputs into tropical forested and savanna grasslands soils, especially on marginal lands, and the results of such research should be disseminated by local extension workers and through publications and newsletters;

(d) Establish national co-ordinating bodies involving government departments, local non-governmental organizations and parastatal bodies, universities, research institutions involved in land, water and soil resources improvement activities which are related to the problems of encroachment on arable land. Such co-ordinating bodies in African countries would be the nucleus for a regional network for soil management in Africa;

(e) Encourage and develop national programmes and pilot projects in selected areas for reafforestation of denuded land, for monitoring of encroachment on arable lands, for soil degradation and for stabilization of sand dunes in the arid land areas, with or without international assistance. Such development activities should be integrated into the medium-term national development planning budget of the country for effective execution;

(f) Examine the provisions of the FAO World Soil Charter (1981), the UNEP World Soils Policy (1982) and the FAO/UNEP Gidelines for the Control of Soil Degradation (1983), in order to develop a national soils and land use policy;

(g) Examine their land tenure systems, agricultural marketing and pricing systems, legislative, institutional and administrative machineries for land use planning, soil and water resources management in order to remove obstacles to achieving the long-term goal of sustainable food production through self-reliant agricultural practices for increasing productivity without soil losses and degradation. These will facilitate the implementation of the United Nations Programme of Action for African Economic Recovery and Development and its related African Priority Programme for Economic Recovery (APPER), 1986-1990.

At the international level:

(a) The United Nations system should provide adequate technical assistance to African countries, at their request, to tackle the problems associated with encroachment on arable lands, by developing national plans of action, programmes and projects for better soil management and land use practices;

(b) International organizations and donor countries should assist in the development of a regional network for soil conservation in Africa, using as the basis the national co-ordinating mechanisms to be developed within each African country for the prevention of encroachment on arable lands, such as is envisaged in the Cairo Programme of Action for African Co-operation on Environment and Development (1986-1991);

(c) The role of international and national non-governmental organizations (NGOs) in developing activities related to the solution of the problem of encroachment on arable lands should be encouraged by governments and all concerned, in view of their demonstrated successes in implementing small-scale and effective national projects on various development issues;

(d) The United Nations system in co-operation with national governments should promote training programmes and publications on soil, water and land degradation, especially within the context of developing a series of regional networks in Africa for solving problems of sand dune stabilization, reafforestation, improvement of pastoral land, river and lake basin development and so on, as indicated in the Cairo Programme of Action above;

(e) International organizations and donor countries having space technology should assist African Governments to monitor encroachment on arable lands in its various forms and make available satellite imageries and related data and techniques for the analyses and interpretation of trends and impacts on development.